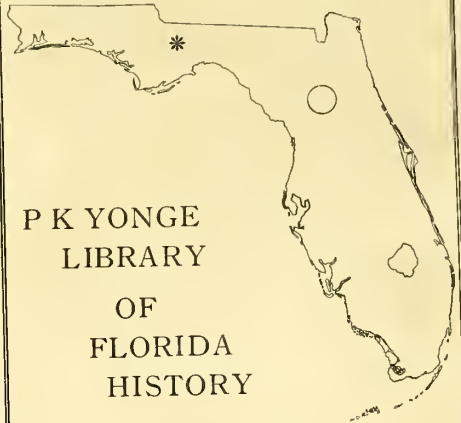


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Florida Limestone

FLORIDA LIMESTONE

The everglades of southern Florida are much the same today as the central portion of the peninsula was when the limestone which now underlies the land was being formed. Of course, at that time the greater portion of Florida was still under water of comparatively shallow depth.

The dinosaurs had long since disappeared from the face of the earth and such weird creatures as the three-toed horse, dire wolf, humpless camel, pigmy rhinoceros, musk deer and giant wart hog roamed the island hammocks or swam the narrow channels of the peninsula.

The water at no place approached the great depths of the Gulf of Mexico on one side or the Atlantic Ocean on the other because beneath it lay the Florida plateau, part of that ancient continent of Apalachia which connected the Allegheny regions with the Yucatan peninsula and South America in earliest geological times. The Florida plateau was still subsiding and most of the limestone was deposited on a sinking ocean floor, which accounts for the extreme thickness of the waving strata of limestone which underlie the land in some places to the depth of 1,000 feet or more.

Streams coming down from the Piedmont plateau to the north brought the mineral, calcite, or calcium carbonate in solution and this was picked up by the sea water and deposited upon the shallow sea bottom to form limestone. This fine mass of calcite in the sediment of the ocean

floor cemented shells and other calcareous matter on the bottom into solid layers of limestone. Lime-secreting algae added their portion, and when finally the land began to rise again after aeons of submergence, streams washed out the surface limestone and deposited it in wide layers along the shores.

Immediately preceding the quaternary period of glacial and modern times was the tertiary period of four geological ages, beginning with the Eocene and ending with the Pliocene. It was during this tertiary period that the limestone deposits were laid upon the basement rocks of the Florida plateau, that ancient land which sank into the sea when the world was young. Florida lay under the sea in Eocene times and it was then that the oldest bed of limestone, known as the Ocala strata, was laid.

Meanwhile the dome of Ocala limestone which outcrops upon the surface at some spots in central Florida began to rise from the sea and during the next two ages of Oligocene and early Miocene times, the peninsula was partly dry land, which sank again, however, in a second submergence during the latter part of the Miocene age when the limestone strata known as Hawthorne formation was deposited.

The uplift of the land was resumed at the close of Miocene times and has continued ever since with the result that much of the upper layer of Hawthorne formation has been carried away by surface streams. It was while Florida was partly dry in Oligocene and early Miocene ages that the

thin and sparse limestone strata called the Tampa formation was deposited in shallow bays and estuaries of the peninsula.

Formation of Florida limestone beds has not been uniform for the reason that an arm of the Gulf of Mexico might have covered one part of the peninsula while another portion of the opposite side was under water from the Atlantic Ocean. Thus limestone deposited in both places would have been contemporaneous although of different characteristics. For this reason, some deposits may have been assigned different names and periods while basically the same.*

All different limestones have one property in common. They consist chiefly of calcite or calcium carbonate (CaCO_3). Lime when chemically pure consists of the oxide of calcium (CaO) which is very active and therefore seldom found in native state outside some compound, usually calcium carbonate, which is formed through the mixture of carbon dioxide (CO_2) with lime.

Pure lime is not readily soluble in water unless the water is charged with carbon dioxide so as to form carbonic acid. H_2O plus CO_2 equals H_2CO_3 (carbonic acid). Rainwater absorbs carbon dioxide from the air and forms carbonic acid while surface drainage comes in contact with decaying vegetable matter in the soil to form carbonic acid. When rain or drainage water encounters calcium carbonate in the soil, the water takes the calcite into solution as calcium bicarbonate. H_2CO_3 plus CaCO_3 equals $\text{CaH}_2(\text{CO}_3)_2$

* Twentieth Annual Report, Florida Geological Survey, pp. 37-36.

(calcium bicarbonate) CaHCO_3 . The calcium bicarbonate is delivered by surface streams to the ocean where the calcite it contains is deposited as limestone.

Calcite is precipitated when sea water becomes supersaturated with calcium bicarbonate or it is deposited by lime-secreting organisms in the water. A large portion of the limestone deposits probably came from shellfish dying and dropping their shells upon the bottom, but most of it was and still is being formed in the shallow tropical seas around the southern tip of Florida and the Bahamas through chemical precipitation of calcium carbonate.

There are three processes of chemical precipitation of lime in sea water, viz. (a) through contact with other chemical compounds, (b) from the sun's heat, and (c) through action of bacteria.

In the first instance, streams become so saturated with lime that they no longer have any excess of carbon dioxide to serve as a solvent for the limestone (CaCO_3). As soon as the stream enters the sea, the water takes in solution certain chlorides and sulphates like salt and gypsum which are present in the sea and more soluble than limestone, some of which is precipitated although the water remains saturated with calcium bicarbonate.

Only a light rise in temperature from the sun's heat or any violent agitation of the water like a hurricane is sufficient to liberate carbon dioxide from sea water. The waters around southern Florida are constantly

receiving from the surface streams large amounts of carbonates with which they are already saturated so that when any carbon dioxide at all is driven off from the sea water it becomes supersaturated and precipitates calcium carbonate.

Evaporation of the sea water through the sun's rays accomplishes the same results by leaving it supersaturated with insoluble calcite, always the first to be precipitated although in case of any considerable evaporation the precipitation of salt and other minerals far outweighs that of calcite.

In the precipitation of calcium carbonate through action of bacteria, it has been found that there are present in the sea around southern Florida and the Bahamas bacteria which thrive upon organic matter in the mud on the bottom and convert nitrates into ammonia. Addition of any strong alkali like ammonia to sea water will precipitate calcium carbonate.

The sea weeds use carbon dioxide just like land plants, the only difference being that one absorbs it from the water and the other takes the carbon dioxide from the air. Withdrawal of carbon dioxide from the water releases calcium carbonate which settles to the bottom to form limestone.*

The Ocala limestone underlies all of Florida with the possible exception of the extreme western part of the State. The dome of Ocala lime-

* A Preliminary Report of Limestones and Marls of Florida, Stuart Mossom, pp. 36-51.

stone lies at or near the surface throughout an area approximately 150 miles long by 60 miles wide, extending from Lacombe on the south to Ellaville on the north and from Ocala and Alachua on the east to the Gulf of Mexico on the west. This area borders the Gulf of Mexico from Homosassa to the mouth of Steinhatchee River. It is only in this dome area that the Ocala limestone is near enough to the surface to quarry.

The Ocala limestone comes near the surface or outcrops in several smaller domes. One of these extends westward from the Chattahoochee River about 50 miles and southward from the Alabama line to Marianna, comprising chiefly what is Jackson County. This area adjoins much larger outcrops of Ocala limestone in Georgia and Alabama and smaller patches of it have been discovered at Duncan on the Chattahoochee River above Westville and along the Alabama line.

A peculiarity of the region where Ocala limestone lies near the surface is that there are few streams, for much of the drainage passes through underground channels. Shallow depressions, sinks, ponds and lakes are numerous throughout the region, however. The Ocala limestone dome area is generally of low relief except where hilly sections have been protected from erosion by sand. The altitude of the dome area ranges from sea level on the coast of the Gulf of Mexico to about 150 feet above sea level west of Ocala and at Lee's Mound near Crystal River.

The Ocala limestone is not of uniform thickness. It extends as far west as the Tombigbee River in Alabama where it is little more than 50

feet thick and merges with a clay formation, also of the upper Eocene period. It extends north into Georgia as far as Albany where it is about 300 feet thick. In the peninsula part of Florida it is around 500 feet thick. The base of the Ocala formation is so deeply buried that underlying deposits have never been examined although it is believed that these are an earlier series of limestones of Eocene age. Near Marianna it is overlaid by what is known as the Marianna deposit of limestone.

The Ocala limestone is the best material for road building in the State. It is somewhat softer than the ideal rock for road building but it binds well and when surfaced with suitable material makes a fairly durable road. It ranges in color from pure white to cream or yellow and in texture is usually granular. Sometimes it consists of a loosely coherent mass of tiny shells and is so porous that water percolates freely through it. Even the harder kinds are pervious to water, and the free circulation of water has facilitated solution of the rock. Sink holes, often filled with other materials, lead downward from the surface and connect with underground passages. In chemical composition as well as physical characteristics, Ocala limestone is remarkably uniform. It consists almost entirely of calcium carbonate and often contains few impurities.

The limestone for road material or lime, is quarried at a number of places.

There are several formations of limestone of Oligocene and Miocene

age overlying the Ocala beds. The Marianna strata is defined as the white limestone overlying the Ocala limestone around Marianna. It probably does not exceed 50 feet in thickness. The formation appears to be entirely lacking in the peninsula which probably stood above water while the Marianna deposit was being laid. The softer and purer parts of Marianna limestone when freshly exposed can readily be cut by saws into blocks that harden into durable building material. It is used principally in construction of chimneys and therefore has come to be known as "chimney rock."

The Tampa limestone occupies three large areas and a few small outlying patches. The typical area lies principally in Hernando, Pasco and Hillsborough Counties but extends beyond them for short distances into Citrus and Sumter Counties. It is more variable in color and texture than Ocala limestone. Several outliers of the Tampa limestone rest upon the Ocala formation near Kendrick and between Lowell and Sparr in Marion County.

The Hawthorne formation appears to rest upon the Tampa limestone although at many places in the peninsula the Tampa strata is lacking entirely and the Hawthorne rests directly upon the Ocala limestone.

There were 38 stone quarries operating in Florida in 1937, with a total production of 1,600,380 short tons valued at \$1,408,749. Needless to say, these were practically all limestone quarries. Limestone is the most widely used of all building stones in the United States but very little dimension stone is quarried in Florida where nearly all production is

crushed stone. The Indiana district furnishes approximately 45 per cent of the limestone used for building purposes in the United States.

Thirty-two active plants in Florida produced 1,551,620 tons of crushed limerock, worth \$1,212,825, in 1937. During the same period, 2,757 plants throughout the United States produced 93,863,690 tons of crushed limestone worth \$65,592,508. There were only four quarries producing limestone for building purposes in the State in 1937. Their production amounted to 5,430 tons, valued at \$102,586. There were three plants in the State producing lime from limerock. Their total sales for 1937 were 19,008 tons worth \$177,929.

Limestone is more extensively used than all other stones because it is widely distributed, can be quarried at moderate cost and forms a necessary ingredient of many commercial products. It constitutes 72 per cent of all crushed and broken stone used in the United States. There has been a large gain in the use of agricultural limestone.

In 1937 uses to which Florida limestone were put were as follows: Riprap, 2,880 tons valued at \$1,755; concrete and road metal, 1,299,410 tons valued at \$1,048,930; railroad ballast, 89,650 tons valued \$47,872; agriculture, 49,300 tons valued at \$83,983; all other uses, 110,380 tons valued at \$30,285. *

Limestone is one of Florida's most abundant minerals and a valuable

* Minerals Yearbook, 1938, pp. 1016-1044.

contributor to the total value of mineral output. This was especially the case during the period of great activity in road construction in 1926 when production reached a peak of 6,572,870 tons worth \$7,177,568.

Its earliest use in Florida was as a building stone as is attested by the stability and durability of Spanish forts, missions and other early structures along the east coast. Limestone was also burnt for mortar from earliest Spanish days.

Florida has one cement plant utilizing limestone of the Tampa formation. The Florida Portland Cement Company has a modern plant at Tampa. The limestone this company uses in the manufacture of cement is obtained from a large quarry 10 miles north of Brooksville and the clay comes from the same vicinity. Use of limestone in the pulp and paper mills is one of the miscellaneous uses that is showing a substantial increase in recent years.

There were three plants putting out agricultural limestone in Florida in 1933. These were the Dixie Lime Products Company of Ocala with quarries at Zuber, Naranja Rock Company at Naranja and the Oakhurst Lime Company of Ocala.

Modern scientific farming has brought about the use of lime as a fertilizer. It has been found that the application of lime, either in the form of raw limestone, hydrated lime ($\text{Ca}(\text{OH})_2$) or quicklime (CaO), will neutralize the acid content in certain acid soils and benefit a great,

variety of crops. There has been some controversy about what is the best form of lime to use. Agricultural lime is produced at Ocala by simply pulverizing the soft limestone. The product is distributed through north Florida and southern Georgia.

When limestone is baked or heated to a temperature of about $900^{\circ}\text{C}.$, carbon dioxide is driven off in gaseous form leaving pure lime, known commercially as lump lime or quicklime. If quicklime is allowed to remain exposed to the air for a sufficient length of time, it will crumble to a powder owing to the absorption of moisture from the air, forming calcium hydroxide $(\text{Ca}(\text{OH})_2)$, i. e. air-slaked or hydrated lime.

Among the plants producing building stone in Florida in 1933 were the Florida Travertine Corporation of Bradenton with quarries near Manatee; C. Ed de Brauer of Miami with quarries at Quarry Key; Mizner Industries, Inc. with quarries near Ellenton and Pennsoco Farming Company, Hialeah.

The Cummer Lumber Company of Jacksonville produces practically all the railroad ballast and riprap from its quarry at Kendrick. Other uses include stones for curbing, flagging and paving as well as rubble stone. The Dixie Lime Products Company of Ocala and the Miami Lime and Chemical Company make commercial lime from limestone.

Among those quarrying limestone for road material and concrete are: Atlas Rock Company, Miami; Camp Concrete Company of Ocala with quarries near Brooksville; Cummer Lumber Company; Dixie Lime Products Company;

Marianna Lime Products Company with quarries near Marianna and Cottondale; Maude Ojus Rock Company of Ojus; Ceala Limerock Corporation with quarries at Newberry and Ceala-Tampa Limerock Company with quarries at York. The Standard Rock Company of Morriston has a quarry at Standard where limerock is quarried for miscellaneous uses.*

* Florida State Geological Survey, Twenty-third and twenty-fourth editions, 1930-32.

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